SYNGUIDER USER'S MANUAL

GETTING STARTED 1

PREPARING THE SYNGUIDER 3

BASIC OPERATIONS 4

OPERATION UNDER THE NIGHT SKY 9

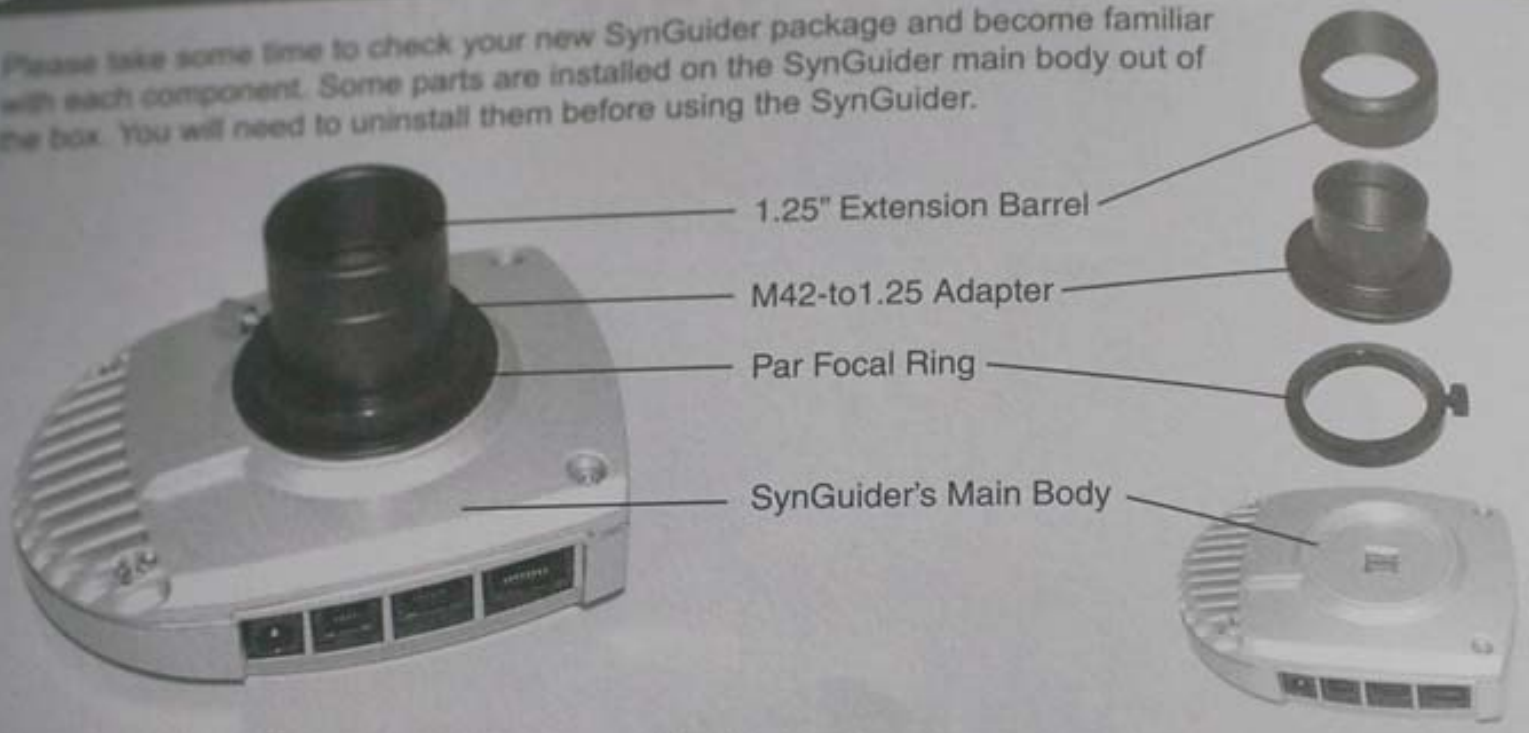
SPECIFICATIONS 15

Thank you for choosing the SynGuider. The SynGuider can guide an equatorial mount without the help of a computer. It will improve the image quality and help you achieve pin-point stars in you long-exposure photography.

180110V1

1 ABOUT THE SYNGUIDER PACKAGE

Please take some time to check your new SynGuider package and become familiar with each component. Some parts are installed on the SynGuider main body out of the box. You will need to uninstall them before using the SynGuider.



**Keep the Serial Cable and the Short-Circuit RJ-45 Plug in a safe place for possible future firmware update.*

SYNGUIDER MAIN BODY ②

FRONT VIEW

REAR VIEW

A. M42 thread
B. CCD Sensor
C. Power Jack
D. Serial Port
E. Autoguider Port
F. Hand Pad Port
G. LCD Screen

③ PREPARING THE SYNGUIDER

PREPARING THE POWER SUPPLY

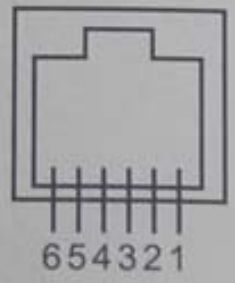
User can use four D type 1.5V batteries (not included) with the battery case as the power supply for SynGuider. To use other power supply, it must match the following requirements:

- DC 6V~14V output voltage, lower voltage is recommended.
- 250mA and up output current
- 2.1mm power plug, central positive

PREPARING THE IMAGING SYSTEM

The basic requirements for the equipment to use with SynGuider are:

- **Telescope Mount**: Equatorial mount, or Alt-Az mount with a wedge, with a dual-axis motor drive attached. The motor drive must be able to accept "ST-4" compatible autoguiding signals.
- **Connecting Cable**: You may use the supplied dual RJ-12 plug autoguiding cable if the pin configuration of your motor drive is the same as the diagram shown on the right. An alternative cable is required if the pin configuration of your motor drive is different.



1= NC
2= Ground
3= +RA (left)
4= +DEC (up)
5= -DEC (down)
6= -RA (right)

- **Guide Scope**: An additional telescope with a M42-0.75 thread or a 1.25" eyepiece holder is required as guide scope. Larger aperture, at least 80mm, helps reduce the exposure time of the SynGuide, thus yielding more accurate guiding result. The ideal focal length is between 400mm and 1200mm. An adjustable guide scope tube ring and a finderscope or red dot finder are recommended for searching for a guide star.

BASIC OPERATIONS 4

It is highly recommended that you familiar yourself with the basic operations of the SynGuider indoors before going out under the dark sky.

ATTACHING SYNGUIDER TO A GUIDE SCOPE

There are two ways to install the SynGuider on a guide scope:

Option 1: The SynGuider can be threaded onto a telescope with a M42 thread adapter. Generally, this installation method provides the most secure connection. It is best suited for the guide scope equipped with a finderscope or a red dot finder.
Option 2: Install the M42-to-1.25 adapter to the main body of the autoguider, and then insert and lock the autoguider into the 1.25 inch eyepiece holder on the guide scope. This installation method is suitable for using a par-focal eyepiece to search for a guide star due to its convenience in exchanging the SynGuider for an eyepiece.

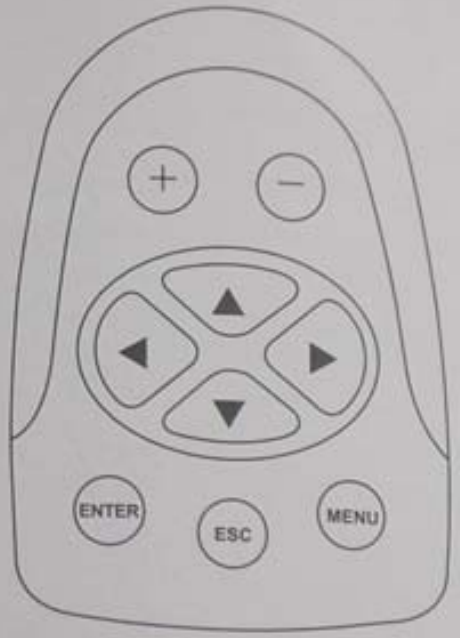
CONNECTING CABLES

Plug the hand pad into the 8 pin RJ-45 connector on the main body of the autoguider.
Plug one end of the guiding cable into the autoguider port on the autoguider and the other end into the equatorial mount. Plug in the battery case or the power supply of your choice.

READING THE LCD DISPLAY

The LCD display is divided into two zones. The left half of the LCD screen is to display text information, such as the menu, data and the status of the device. The right half of the LCD screen is to display the image captured by the optical sensor. In the screen, stars are represented by dots.

USING THE HAND CONTROL



There are nine illuminated buttons on the hand pad:
Menu: Used to open up or close the main menu.
ESC: Used to cancel an operation or quit from the menu.
Enter: Used to enter a submenu or confirm an operation.
+: Used to increase the exposure time.
-: Used to decrease the exposure time.
Up/Down buttons: The function of these buttons depends on the working mode of the autoguider:

- Preview Mode: Manually toggle the Dec+ and Dec- signal of the ST-4 autoguider port.
- Menu Mode: Scroll between the menu items.
- Data Input Mode: Change the parameters.
- "Manually Lock Guider Star" Mode: Move the small pick-up crosshair vertically.
- Guiding Mode: Set the Dec correction aggressiveness.

Left/Right buttons: The function of these buttons depends on the working mode of the autoguider:

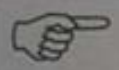
- Preview Mode: manually toggle the RA+ and RA- signal of the ST-4 autoguider interface.
- Menu Mode: The right button is to enter a submenu. The left button is to confirm a menu operation. It performs as the *Enter* button.
- Data Input Mode: The left button is to confirm a menu operation. It performs as the *Enter* button.
- "Manually Lock Guider Star" Mode: Move the small pick-up crosshair horizontally.
- Guiding Mode: Set the RA correction aggressiveness.

OPERATING THE MENUS

Press the Menu button to activate the main menu tree. Use the *UP* or *DOWN* buttons to scroll among the menu items. Press the *ENTER* or the *RIGHT* button to choose between the following submenus:

LOCK or RE-LOCK Menu: This submenu is used to lock a star in SynGuider's field of view (FOV) for later guiding operation. After entering this submenu, use *UP* or *DOWN* button to choose from the following options and then press *ENTER* or *LEFT* button to confirm:

- AUTO: the SynGuider will try to automatically lock the brightest star in the FOV.
- MANUAL/RE-LOCK: the SynGuider will show a small pick-up crosshair in the image area of the LCD display, where you can use the four direction buttons to move the crosshair onto or near a star. Press *ENTER* to lock the SynGuider on the star.
- NO: allow the SynGuider to exit from the locked mode or guiding mode and return to the preview mode



Look to the upper left corner of the LCD display to find out which mode the SynGuider is currently working under.

ZOOM Menu: This menu is activated only when the SynGuider is working under the preview mode. It is used to zoom in on the image. Using the *UP*/*DOWN* buttons, choose between the zoom level 1 (the entier image), 2 (the central 256X256 pixels of the image sensor), 3 (the central 128X128 pixels of the image sensor) and 4 (the central 64X64 pixels of the image sensor). After choosing the level, press *ENTER* to confrim or *ESC* to keep the previous zoom level.

GUIDE Menu: This menu is used to activate or de-activate autoguiding. Use the *UP/DOWN* button to choose from the following three options:

- AUTO CAL: The SynGuider will start an auto-calibration routine prior to the start of autoguiding.
- RESUME: The SynGuider will immediately start autoguiding with the previous guiding parameters.
- NO: The SynGuider will stop autoguiding and return to the locked mode.

SWAP Menu; This menu is used to manually set the polarity of the control signal. Choose between the following three polarity settings and then press *ENTER* to confirm:

- SWAP N-S: Swap the Dec+ and Dec- signals.
- SWAP E-W: Swap the RA+ and RA- signals.
- SWAP X-Y：Determines how the orientation of the autoguider matches the RA/Dec axis of the mount. When it is set to "NO", the horizontal(X) direction of the optical sensor and the LCD display is used to detect drifting in RA. When it is set to "Yes", the vertical(Y) direction of the optical sensor and the LCD display is used to detect drifting in RA.

It is not necessary to use the SWAP Menu to manually set the polarity of the control signal if you choose the "AUTO CAL" option in the GUIDE Menu.

CROSS Menu: This menu is used to turn on the crosshair on the LCD screen. The centre of the crosshair represents the centre of the image sensor. The crosshair can also be used to roughly calculate the positioning of a star in the field of view (FOV).

DEC BACKLASH Menu: To reduce the influence of Dec axis' backlash during autoguiding, the SynGuider can send a Dec+ or Dec- control for a pre-determined time when the SynGuider changes the polarity of the Dec control signal. Once this menu is selected, you will see the current setting displayed in the text zone of the LCD screen. Use *UP/DOWN* buttons to change the value. Press *ENTER* or *LEFT* button to confirm. If your equatorial mount has no or minimal backlash, or if you have done very accurate polar alignment, the Dec backlash should be set to 0.

NOISE Menu: This menu is used to set the background noise control in the SynGuider. When there are multiple stars in the SynGuider's field of view (FOV), the noise menu can also be used to filter out dimmer stars and reduce the chances of misidentifying the guide star during auto-guiding.

Higher value of the noise setting leads to a stronger filter effect, but it may affect SynGuider's ability to detect fainter stars. Lower value allows the SynGuider to see fainter stars, but tends to introduce noise, therefore, resulting in less accurate auto-guiding. The average value is between 8-15. The most suitable noise value depends on a multiple of factors, including the exposure time, the darkness of the sky, and the surrounding temperature. In general, longer exposure shots, higher surrounding temperature, and light-polluted skies tend to introduce more background noise. It is best to choose higher noise value in these circumstances.

You may start with setting the noise to a smaller value so that the image zone of the LCD shows a blank screen, and then gradually increase the value until the image zone just becomes completely black. It is best to choose Zoom Level 1 in order to get a clear image of the entire FOV.

RESET Menu: This menu resets all the settings back to the factory default settings.

9 OPERATING UNDER THE NIGHT SKY

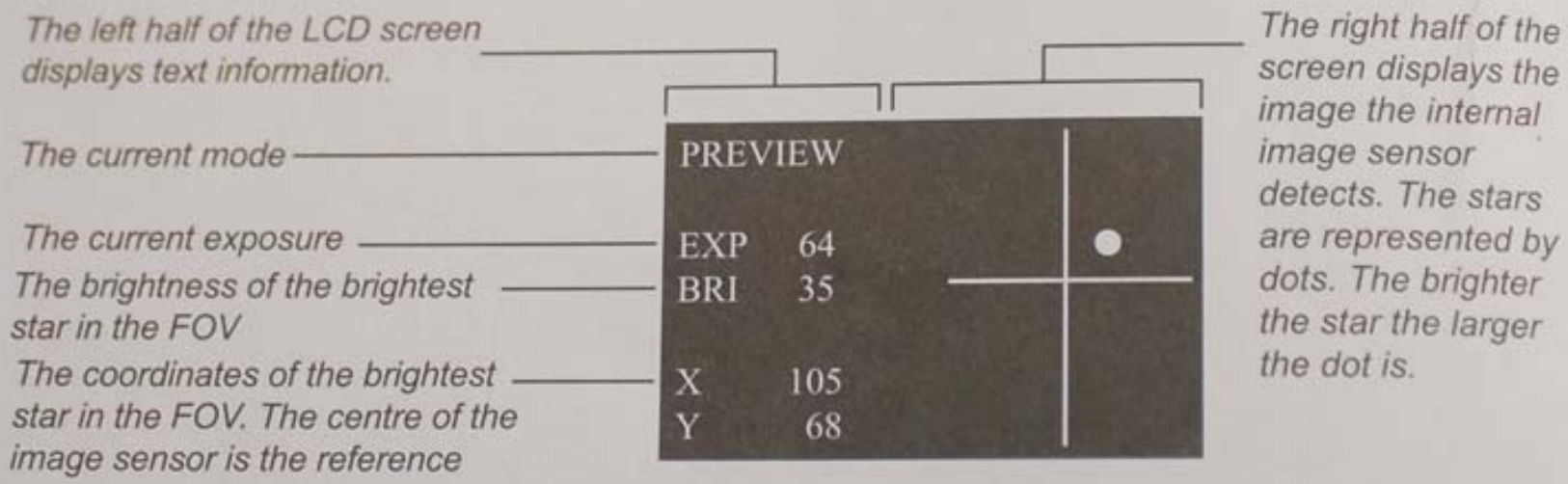
The key steps of operating the SynGuider are:

Step 1: Adjust the focus (PREVIEW mode)
Step 2: Find and lock a guide star (LOCKED mode)
Step 3: Start autoguiding (GUIDING mode)

The following sections explains the practical operations of the SynGuider:

ADJUST FOCUS (PREVIEW MODE)

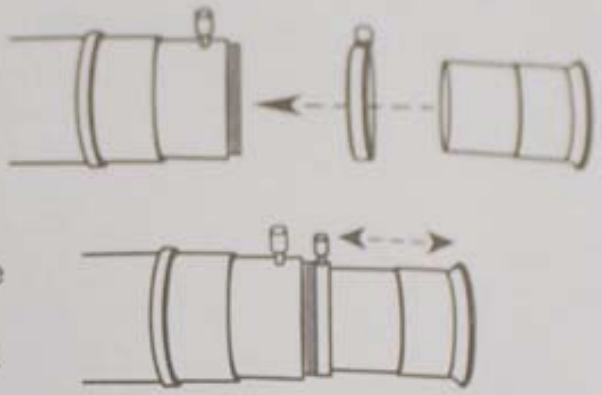
The SynGuider enters the PREVIEW mode as soon as the power is turned on. Following is an example of what you will see.


The left half of the LCD screen displays text information.
The current mode
The current exposure
The brightness of the brightest star in the FOV
The coordinates of the brightest star in the FOV. The centre of the image sensor is the reference
PREVIEW
EXP 64
BRI 35
X 105
Y 68
The right half of the screen displays the image the internal image sensor detects. The stars are represented by dots. The brighter the star the larger the dot is.

Follow these steps to adjust the focus of the guide scope:
1). Insert an optical eyepiece into the eyepiece holder of the guide scope. Activate tracking of the mount. Center a bright star in the eyepiece's field of view.
2). Remove the optical eyepiece and replace it with the SynGuider.
3). Use the "+" or "-" buttons on the hand pad to set the exposure time to 256 milliseconds.
4). Use the NOISE Menu to set the noise control level until the LCD is free of background noise.
5). Adjust the focuser of the guide scope until the image of the bright star appears in the LCD as a blank dot. Continue to adjust the focuser until the the blank dot appears to be smallest, suggesting that the image is in focus. At this point, if you continue to turn the focuser you will see that the dot becomes larger again. The BRI reading will increase as the image comes into focus. If the BRI reading increases to over 100, use the "-" button to reduce the exposure time to avoid over-exposure.
6). Use the controller of the equatorial mount to slowly move the star into the center of the image display area.
7). The default zoom level is 1. Set the zoom level to 2 or 3 so you can zoom in on the star. Fine-tune the focuser to obtain the smallest star image and the highest BRI reading. Lock the focuser of the guider scope and remove the SynGuider from the guide scope.
8). Now it is the time to make a par-focal eyepiece for later use. A par-focal eyepiece can be used to locate the guide star, or to adjust the focus of the guider scope for subsequently setting up the guider scope.

Follow these steps to make a par-focal eyepiece:

1). Loosen the locking screw on the par-focal ring. Insert an optical eyepiece into the eyepiece holder through the par-focal ring, as shown on the right.
2). Slowly move the eyepiece in and out of the eyepiece holder until the image of the star is the sharpest. Keep the eyepiece still with one hand, and firmly push the par-focal ring against the eyepiece holder with one finger, while tightening the locking screw on the par-focal ring with the other.
3). The par-focal ring should be firmly attached to the eyepiece. You may remove the eyepiece from the guide scope now.



Attach the 1.25" extention barrel to the eyepiece if the eyepiece is too short to reach focus.

Follow these steps to align the orientation of the autoguider with the moving direction of the two axes of the equatorial mount:
1). Turn on the crosshair on the LCD screen using the CROSS menu.
2). Adjust the autoguider so that when the equatorial mount is slowly slewing in RA axis the star image moves parallel to either the horizontal or the vertical line. Instead of using the hand control of the mount, you may also use the LEFT/RIGHT direction buttons on the SynGuider hand pad to control the RA axis of the mount.

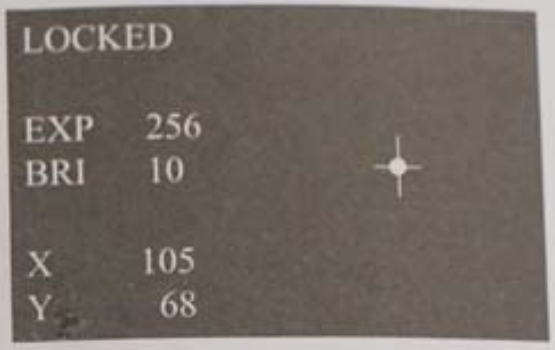
Remember or mark the position of the SynGuider on the guide scope so you won't have to perform the autoguider alignment again.

FINDING AND LOCKING A GUIDE STAR

1). Point the primary telescope to the target deep sky object (DSO). Activate tracking on the equatorial mount. The guide scope should also be pointed to the same region in the sky.
2). Attach the par-focal eyepiece to the guide scope. Locate a brightest star nearby and adjust the guide scope so the star appears in the center of the par-focal eyepiece's FOV.
3). Replace the par-focal eyepiece with the SynGuider.
4). The image of the star should appear in the image zone of the LCD screen. If not, use the "+" button to increase the exposure time until the image of the star appears. Use the NOISE menu to filter out the noise if the image zone of the LCD screen becomes blank or the background noise becomes too apparent.
5). Now is a good time to adjust the exposure time. Generally speaking, shorter exposure gives better periodic error correction results. The BRI reading on the screen is a good reference. The minimum BRI reading required for the SynGuider to work stably is 10. Try to bring the BRI reading down as close to 10 as possible for the best result.
6). Adjust the guide scope to bring the star to the center if it is too close to the edge of the image zone on the SynGuider. This is only necessary when the ZOOM level is set at 1.
7). Lock the guide star automatically or manually using the LOCK menu.

If the guide star is successfully locked the SynGuider will enter the "LOCKED" mode. The ZOOM level will automatically be switched to 4, and SynGuider will display an area of 64*64 pixels near the locked star. The SynGuider will keep tracking the star as it slowly drifts away from its original position.

A small cross will also display on the screen to indicate the center of the star. The coordinates of the star will be displayed in the text zone of the LCD. The diagam on the right is what you will see in the LOCKED mode.



AUTOGUIDING (GUIDING MODE)

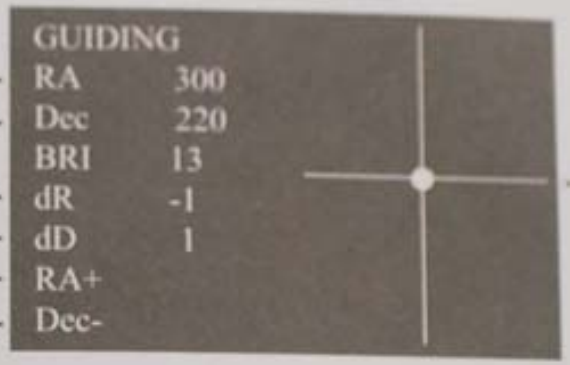
Once the SynGuider is successfully locked onto a star, you may active guiding with the GUIDE menu.

Activate Autoguiding

AUTO CAL: This is recommended when the telescope has been moved to a new object. It will start an auto-calibration routine to detect the correct setting of the guiding parameters, including control signal polarity ("SWAP N-S", "SWAP E-W" and "SWAP X-Y" parameters) and the controlling aggressiveness for the RA and Dec axes. SynGuider will automatically start autoguiding after the calibration is finished successfully.

RESUME: This is to resume previous autoguiding. SynGuider will skip the auto-calibration routine and start autoguiding with the previous guiding parameters.

The following diagram is what you will see in the GUIDING mode.



RA and Dec agressiveness. The unit is milliseconds/pixel.

The drift in RA

The drift in Dec

Indication that the SynGuider is sending RA+/RA- or Dec+/Dec- signals via the autoguider port.

A crosshair is displayed for you to monitor the effects of autoguiding. The center of the cross is the position of the guide star when guiding is activated.

Operations

The guiding agressiveness of RA or Dec axis can be adjusted with the direction buttons on the hand control. Use the RIGHT/LEFT buttons to increase/decrease the RA aggressiveness and the UP/DOWN buttons to increase/decrease the Dec agressiveness. If the SynGuider losses the guide star during autoguiding it will prompt "STAR LOST". Press ESC or OK return to the PREVIEW mode and start over. To avoid vibrations on the SynGuider, disconnect the hand pad during autoguiding.

Suspend Autoguiding

Use menu GUIDE/STOP to stop autoguiding. The exposure on the photographic camera should be stopped before suspending autoguiding.

SPECIFICATIONS

IMAGE SENSOR
Type: SONY ICX404AL CCD Sensor
Chip size: 5.59mm(X) * 4.68 mm(Y)
Number of effective pixels: 510(X) * 492(Y)
Unit cell size: 9.6um(X) * 7.5um(Y)
Formula for angular resolution in arc second:
Resolution(X) = 2261 / FL
Resolution (Y) = 1962 / FL
FL is the focal length of the guide scope in millimeters.

POWER SUPPLY
DC 6V~14V, 250mA
Power Jack: 2.1mm, tip positive

EXPOSURE TIME
1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 mS

SENSITIVITY
Typically, the SynGuider can capture and guide a star with up to the magnitude of 8 under the following conditions: Regular 80mm aperture refractor, 2048ms exposure time, and good seeing conditions